

THE IMPACT OF COMPUTER SIMULATIONS ON PERFORMANCE AND RETENTION OF STUDENTS IN QUALITATIVE ANALYSIS AT SENIOR SECONDARY SCHOOLS IN ZARIA, KADUNA STATE

By

S. B. Olorukooba¹, Sanda San² and Suleiman Kazeem³

¹Department of Science Education,

Faculty of Education,

Ahmadu Bello University, Zaria.

^{2,3}Department of Science Education,

Faculty of Technology Education,

Abubakar Tafawa Balewa University, Bauchi.

olorukoobasaratu@gmail.com, ssandabtr@gmail.com, kazeemsuleiman013@gmail.com

ABSTRACT

The study investigated the impact of Computer Simulations and Traditional Lecture method on students' performance in Qualitative Analysis concept of Chemistry in Senior Secondary Schools of Zaria Education Zone, Kaduna State-Nigeria. Three Research objective, Questions and Hypotheses were formulated to guide the study. A systematic random sampling was used to select 100 students from a population of 2852. Pretest-posttest-quasi Experimental-Control Research design was used in the study. The experimental group was taught using computer simulation and the control group was taught using Lecture method for a period of 6 weeks. Qualitative Analysis Performance Test with reliability coefficient of 0.65 was used as an Instrument for the study. Descriptive statistics was used to answer the research questions and t-test was used to test the research hypotheses at $P < 0.05$ significant level. The results showed that; students taught with computer simulation performed better than those taught using lecture method; computer simulation is gender friendly. Finally, it was recommended that Chemistry teachers should adopt computer simulation teaching techniques in teaching Chemistry in view of its high facilitative impacts on students' academic performance.

INTRODUCTION

Chemistry is one of the compulsory subjects for one to study science/technology related courses in tertiary institutions. It is the science that deals with the properties of different atoms, the ways in which they join together to form molecules, the interaction of various kinds of molecules with one another and the accompanying energy changes. It is the heart or nucleus of science (Adeyemo, 2005).

The objectives of Chemistry as provided in the National Policy of Education (FME, 2013) are as follows:

(i) Facilitate a transition in the use of scientific

- (ii) concepts and techniques acquired in Chemistry.
- (ii) Provide the students with basic knowledge in chemical concepts and principles through efficient selection of content and sequencing.
- (iii) Show Chemistry in its inter-relationship with other subjects;
- (iv) Show Chemistry and its link with industry, everyday life, benefits and hazards;
- (v) Provide a course which is complete for students not proceeding to higher education while it is at the same time, a reasonably adequate foundation for post-secondary Chemistry

courses (FME, 2013).

Objectives of teaching and learning of chemistry as stated in the Nigerian secondary school curriculum is yet to be achieved. Innovative advances in technology have introduced a variety of tools to enhance learning in higher education. Among these, computer simulations have been used; to support a variation of cognitive learning styles; to facilitate higher order thinking and problem solving skills, and to augment differential, collaborative, and mastery learning (Guy & Lownes-Jackson, 2015). A widely acceptable tool for teaching and learning, computer simulations combines visual and interactive learning experiences, promotes application of knowledge, and provides a simplified representation of real world systems (Eskrootchi & Oskrochi, 2010). Scholars ascertain that guided discovery, deliberate practice, and engagement in active learning by means of computer simulation leads to enhanced performance and retention of concepts (West & Veenstra, 2012).

Computer simulations has significant effect in improving the attitude of students towards Biology and was found to be a suitable method of instruction to both males and females students alike (Nireti, Morenike, & Joyce, 2014). Proponent affirm that Computer Simulations promote student interest and involvement, foster retention of information, and offers opportunities for affective and behavioral learning (Guy & Lownes-Jackson, 2015).

Computer simulations allow students to create and explore situations that they would not normally be able to witness. They can repeat trials instantly and quickly change variables to understand the effects of change. "A computer enables repeated trials of an experiment with considerable ease in a limited time, provides immediate feedback, allows simultaneous observations of graphical representations and offers a flexible environment that enables students to proceed with their own plans" (Kara, 2008).

Chemistry is one of the science subjects which have been taught using different methods for instance, Ifeakor used commercially produced Computer Assisted Instructional package to teach chemistry (Ifeakor, 2006), while Ajidagba and co. used Concept mapping and analogy to teach chemistry yet students' performance in chemistry is not encouraging. The reasons for poor performance in chemistry as identified by the following researchers include: poor instructional strategies (Olorukooba, 2007); abstract nature of science concepts (Nsofor, 2006); lack of qualified teachers (Biodun, 2004); poor infrastructure and inadequate laboratory facilities (Shawl, 2003); and non-availability and utilization of instructional materials (Yusuf, 2007). Also the chief examiner, West African Examination Council (WAEC, 2007), identified some areas of weaknesses of the students/candidates which were reported as a contributing factor to student's poor performance. The areas identified include: poor understanding of general principle and concepts, poor identification of colours, lack of proper observation, inability to make inferences and draw conclusion during qualitative analysis.

Objectives of the Study

This study has the following objectives to:

1. Investigate the impact of Computer Simulations package on academic performance of Chemistry Students in Secondary School
2. Determine whether the use of Computer Simulation enhances Retention of students towards Chemistry in Secondary Schools.
3. Examine the impact of Computer Simulation on gender and academic performance in Secondary Schools.

Research Questions

1. What is the impact of Computer Simulations package on academic performance of Chemistry Students in qualitative analysis

- concept of chemistry and those taught with lecture method alone?
2. What is the impact of Computer Simulation on secondary school students' Retention towards qualitative analysis concept of chemistry?
 3. What is the impact of Computer Simulation on gender and academic performance in Secondary Schools?

Research Hypotheses

Based on the research questions, three null hypotheses was formulated and tested at $P \leq 0.05$ level of significance.

- H_{01} : There is no significant difference in the mean academic performance scores of chemistry students taught qualitative analysis concept of chemistry using computer simulations and those taught with lecture method alone.
- H_{02} : There is no significant difference in the Retention of chemistry students' taught

qualitative analysis concept of chemistry using computer simulation and those taught with lecture method alone.

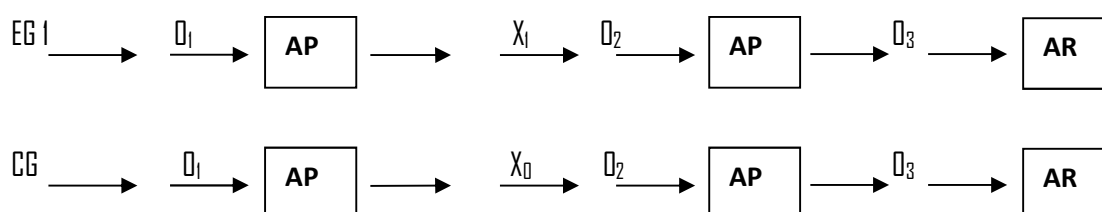
- H_{03} : There is no significant difference in the academic performance mean scores of Male and Female Chemistry students taught Qualitative Analysis Concept of Chemistry using computer simulation.

METHODOLOGY

Research Design

The study utilized a quasi-experimental and control group of pre-test and post-test group design (Sambo, 2008). This was made up of two groups: Experimental and Control. Both groups were pre-tested to determine the equivalence of performance. The experimental group was exposed to computer simulation method of instruction for a period of six weeks while the control group was not.

The design is illustrated in figure 1



Where

EG = Experimental Group

CG = Control Group

X 1 = Computer Simulation (Treatment)

X 0 = Lecture Method alone (Control)

Q₁ = Pre-test (to establish equivalence academic performance before treatment)

Q₂ = Post-test (to determine academic performance after treatment)

Q₃ = Post-post-test (to determine academic Retention)

Population of the Study

The population of the study comprised of all the Public Senior Secondary Schools in Zaria metropolis.

Table 1: Population of the Study

S/N	School Type (public)	Location	Sex		Total
			Male	Female	
1	GSS Aminu	Aminu Road	50	30	80
2	GSS T/Jukun	T/Jukun	50	40	90
3	GSS K/Jatau	K/Jatau	63	37	100
4	GSS Zaria	Zaria City	-	80	80
5	GSS Bogari	Zaria City	40	60	100
6	GSS Yakasai	Zaria City	64	35	99
7	GSS K/Koyambana	Zaria City	40	30	70
8	GSS T/Saibu	T/Saibu	58	35	93
9	GSS K/Doka	Zaria City	70	25	95
10	GSS Aba	Zaria	29	02	31
11	GSS Muchia	Sabon Gari	150	100	250
12	GSS Matari	Zaria	25	10	35
13	GSS Dinya	Zaria	35	12	47
14	GSS Chikaji	Chikaji	125	95	220
15	GSS Gimba	Zaria	44	16	60
16	GSS Dakachi	Dakachi	136	54	190
17	GSS Pada	Zaria City	00	120	120
18	GSS D/Bauchi	Sabon Gari	00	150	150
19	GSS Awai	Zaria	50	10	60
20	GSS Gyellesu	Gyellesu	80	40	120
21	GSS Karau Karau A	Karau K/Zaria A	14	1	15
22	GSS Kinkiba	Zaria	40	08	48
23	GSS Chindit Barracks	Zaria	60	50	110
24	Barewa College	Gaskiya	150	-	150
25	GSS K/Gaya	Zaria City	00	100	100
26	GSS Magajiya	Zaria	80	39	119
27	GSS (WTC) Kongo	Zaria	00	100	100
28	GSS Al-huda huda	Zaria	120	00	120
29	GSS Likoro	Zaria	60	00	60
TOTAL			1410	239	2852

Source: Zaria Education Zone, 2016

Sample and Sampling Techniques

The sample of this study covered a total of 100 Senior Secondary Schools II Chemistry Students from three (3) public schools in Zaria Educational Zone, Kaduna State. The choice of this sample is in line with Central Limit

Theory that recommended minimum of 30 samples (Sambo, 2008). The sample was randomly selected from the three (3) public schools using a systematic random sampling technique (Kerlinger, 1973).

Table 2: Sample Selection for the Study

S/NO	TYPE	SCHOOL	SEX		TOTAL
			Male	Female	
1	Control	GSS Magajiya	30	20	50
2	Experimental Group I	GSSChindict Barracks	30	20	50

Source: Zaria Education Zone, 2016

INSTRUMENTS

The instrument used to collect data was Qualitative Analysis Performance Test (QAPT). The Qualitative Analysis Performance Test (QAPT) comprised of three sections ABC. Section A seeks for background information about the students as follows: Name of School, Age, Class, and Sex. Sections B comprised of thirty (30) objective questions with five stem and one correct option for candidate to select the correct option from the distractors. Section C was thirty (30) subjective test for candidate to fill the correct option into the blank spaces provided. In developing the test items, the pattern of both National Chemistry Curriculum and West African Examination Council (WAEC) and National Examination Council (NECO) tests development procedure which conducts Senior Secondary School Certificate Examinations in the country was adopted.

The researcher concentrated on qualitative inorganic analysis, which is made up of six topics. However, the researcher derived his analysis from one aspect which is general reaction of cat ions with sodium and ammonium hydroxide, which is part of the SS II

Chemistry Syllabus. The Qualitative Analysis Performance Test (QAPT) was administered to both the experimental and the control groups as pre-test and post-test. A marking scheme was designed for making the samples as well. Each of the items in the questions was assigned one (1) mark each. The total score for QAPT was 60 marks.

Validation of Research Instrument

The research instrument Qualitative Analysis Performance Test (QAPT) was validated by a panel of three qualified experts with minimum qualification of Phd and Senior Lecturers in the Department of Science Education, Federal University Dutsinma. They were given copies of the instrument and validated by them.

Reliability

The reliability coefficient of the instruments (QAPT) was determined using test-retest. The instruments were field tested with 20 secondary school students offering Chemistry that did not participate in the study to determine reliability of the instrument. A reliability coefficient of 0.65 was obtained.

RESULTS

The study put to test the three null hypotheses in order to find answers to the research questions. The significance level of 0.05 was adopted as bases for accepting or rejecting a null hypothesis. Before the commencement of the treatment pre-test was used to establish the equivalence of the two groups and the

calculated t-test showed that the students in the two groups were of similar abilities before treatment.

Research Question 1

What is the impact of Computer Simulations package on academic performance of Chemistry Students in qualitative analysis concept of chemistry and those taught with lecture method alone?

Table 3: Descriptive statistics of the Mean Academic Performance Scores of Experimental & Control group

Group	N	X	SD	SE	Mean Diff.
EG	50	15.18	3.75	43.41	2.83
CG	50	12.35	2.75	9.71	

Table 3: shows the average performance score of Chemistry students taught Qualitative Analysis Concepts of Chemistry using computer simulation to be 15.18 and standard deviation of 3.75. Those taught Qualitative Analysis Concepts of Chemistry with Lecture Method alone had mean score of 12.35 with standard deviation of 2.75. The result therefore showed that those students exposed to computer simulation method of

teaching performed better than those students taught with lecture method alone.

Research Question 2:

What is the impact of Computer Simulation on Secondary school Chemistry students' Academic Retention towards Qualitative Analysis Concept of Chemistry?

Table 4: Descriptive Statistics for Retention

Variable	N	X	SD	SE	Mean Diff.
EG	50	15.20	3.33	43.43	3.43
CG	50	11.80	3.07	11.89	

Table 4 shows the mean score of Academic Retention of the experimental group to be 15.20 with standard deviation of 3.33. The mean score of the control group was 11.80 with standard deviation of 3.07. The result therefore showed that Chemistry students taught Qualitative Analysis Concepts of Chemistry has more

retention ability than those taught with lecture method alone.

Research Question 3

What is the impact of Computer Simulation on Gender and Academic Performance in Secondary Schools?

Table 5: Descriptive Statistics in the Mean Scores of Male and Female Experimental Group

Variable	N	X	SD	SE	Mean Diff.
EG	28	24.10	6.54	42.70	0.34
CG	22	23.76	6.38	7.45	

Table 5 shows the mean academic performance scores of male and female Chemistry students' taught Qualitative Analysis Concept of Chemistry using Computer Simulations to be 24.10 and 23.76 respectively. The difference in the mean academic performance between male and female students is 0.34, in favor of male students.

Research Hypothesis 1:

There is no significant difference in the mean academic Performance Scores of Chemistry Students taught using Computer Simulations and those with lecture method alone.

Table 6: t-test Analysis for Academic Performance

Variable	N	X	SD	SE	Df	tcal	tcrit	P	Remark
EG	50	15.18	3.75	43.41	98	3.51	1.66	0.001	Significant
CG	50	12.35	2.75	9.71					

Significant at $P \leq 0.05$

From table 6, the calculated P-value (0.001) is less than $P=0.05$ level of significance at df 98. The mean score calculated were 15.18 and 12.35 for experimental and control groups. Therefore, there is significant difference. Hence, Chemistry students taught Qualitative Analysis Concept of Chemistry using Computer Simulations perform better than those taught with lecture

method alone. The hypothesis of no significant difference in academic performance is therefore rejected.

Research Hypothesis 2:

There is no significant difference in the Academic Retention of Chemistry students taught Qualitative Analysis Concept of Chemistry using Computer Simulations and those taught with lecture method alone.

Table 7: t-test Analysis for Academic Retention

Variable	N	X	SD	SE	Df	tcal	tcrit	P	Remark
EG	50	15.20	3.33	43.43	98	4.51	1.66	0.001	Significant
CG	50	11.80	3.07	11.89					

Significant at $P \leq 0.05$

From table 7, the calculated P-value (0.001) is less than $P=0.05$. The level of significance at df 98. The mean average calculated were 15.20 and 11.80 for the experimental and control groups respectively. Therefore, there is significant difference. Hence, Chemistry students taught Qualitative Analysis Concept of Chemistry using Computer Simulations had more academic retention ability than those taught with lecture method alone. The

null hypothesis of no significant difference in Academic Retention of Chemistry Students is therefore rejected.

Research Hypothesis 3:

There is no significant difference in the Academic Performance Mean Scores of Male and Female Chemistry Students taught using Computer Simulation.

Table 8: t-test Analysis for Male and Female Academic Performance

Variable	N	X	SD	SE	Df	tcal	tcrit	P	Remark
EG	28	24.10	6.54	42.70	48	0.33	1.67	0.75	Not Significant
CG	22	23.76	6.38	7.45					

Significant at $P \leq 0.05$

Table 8 above showed that calculated P-value (0.75) is greater than $P=0.05$ level of significance at df 48. The calculated Academic Mean Performance scores for both male and female Chemistry students in the experimental group were 24.10 and 23.76 respectively. The result showed that there is no significant difference in the average performance of male and female students taught Qualitative Analysis Concepts of Chemistry using Computer Simulations. The null hypothesis of no significant difference is therefore retained. This implies that Computer Simulations Method of instructional delivery is gender friendly.

DISCUSSION OF RESULTS

The first research question aimed at exploring the impact of computer simulations on academic performance. This was answered through descriptive statistics as displayed on table 3 the mean score of the experimental group is greater than the mean score of the control group. Therefore, there is a significant and meaningful difference between the experimental and control groups performance during instructional delivery. In addition an independent t-test was used to find out if the difference between the two groups was statistically

significant. According to table 6; hypothesis of no significant difference in the mean academic performance scores rejected. The finding corroborates with the findings of Nireti et al (2014) who observed that computer simulations significantly improved the academic performance of Biology students.

The second research question which aimed at exploring the instructional method which enhances students' Retention during instructional delivery was answered through descriptive statistics as displayed in table 4. The mean score of the experimental group is greater than the mean score of the control group during the instructional delivery. Therefore, there is significant and meaningful difference between the experimental and control group. A t-test was also computed to test the null hypothesis of no significant difference in academic Retention. It was found out that the observed t-value on table 7 was greater than the t-critical. Hence, the null hypothesis of no significant difference in Retention was rejected, the finding corroborates with the findings of Guy & Lownes-Jackson (2015) and that of West & Veenstra (2012) who observed that simulation model of instruction enhances retention of junior school students in basic science.

The third research question which was aimed at exploring the impact of computer simulation on the performance of male and female chemistry students during instructional delivery was answered through descriptive statistics as illustrated in table 5. The mean score of male and female in the experimental group was almost the same. A t-test was run to test the null hypothesis of no significant difference in the performance of male and female Chemistry students during instructional delivery. The calculated t-value (observed) was less than the t-critical in table 8. Hence, the null hypothesis of no significant difference in the academic performance mean scores of male and female Chemistry students was retained. The findings corroborates with the findings of Nireti et al (2014) who observed that there is no significant difference in the academic performance scores of male and female students in basic science.

CONCLUSION

Based on the findings, it was concluded that computer simulations had a significant impact on the performance and retention ability of Senior Secondary School Chemistry students during instructional delivery. The study also revealed that computer simulations is gender friendly.

RECOMMENDATIONS

From the findings of this study, the following recommendations are made:

- I. Chemistry teachers should adopt computer-based simulation technique in teaching Chemistry Concepts in view of its high facilitative impact on student's academic performance.
- II. Computer simulation instructional method should be adopted in our school system as a major teaching and learning strategy.
- III. The curriculum of teacher training institutions should be reviewed so as to build science

teacher capacity for effective use of computer simulation package in senior secondary schools.

REFERENCES

- Adeyemo, D. A. (2005). Perantant Involvement, Interest in Schooling and School Environment as Predictors of Academic Self-efficacy among Fresh Secondary Schools Student in Oyo State, Nigeria. *Electronic Journal of Research in Educational Psychology*, 53(1), 163-180.
- Biodun, K. (2004). *A comparative Study of The Effects of Teacher Qualification and Teaching Method on Students Achievement in Chemistry*. University of Calabar.
- Eskrootchi, R., & Oskrochi, G. R. (2010). A Study of The Efficacy of Project-Based Learning Integrated with Computer-Based Simulation-STELLA. *Educational Technology and Society*, 13(1), 236-245.
- FME. (2013). *National Policy on Education* (4th ed.). Yaba, Lagos.
- Guy, R. S., & Lownes-Jackson, M. (2015). The Use of Computer Simulation to Compare Student Performance in Traditional Versus Distance Learning Environment. *Issues in Informing Science and Information Technology*, 12, 95-109.
- Ifeakor, O. (2006). The Status of Resources for Effective Teaching of Chemistry in Nigerian Secondary Schools. In *47th STAN Annual Conference*.
- Kara, I. (2008). The Effect on Retention of Computer Assisted Instruction in Science Education. *Journal of Instructional Psychology*, 35(4).
- Kerlinger, F. N. (1973). *Foundation of Behavioural Research*. New York, USA: Holt and Winscon.
- Nireti, D., Morenike, O., & Joyce, O. (2014). Effects of Computer Simulation Package, Gender and Perantant Education on Nigerian Secondary School Students' Attiitude Towards Biology. In *21st Century Academic Forum Conference* (pp. 114-136).

- Boston, MA U. S. A.
- Nsofor, C. C. (2006). Assessing the Effects of Designed Instructional Model on Students' Performance in Science. In *2nd School of Science and Science Education Conference* (pp. 391-398). FUT, Minna.
- Olorukooba, S. B. (2007). Science, Technology and Mathematics (STM) Education is for All Students: Promoting Effective Teaching of STM Subjects in Our Schools Through Teacher Preparation. In *50th Anniversary Conference of Science Teachers Association of Nigeria* (pp. 3-6). STAN.
- Sambo, A. A. (2008). *Statistical Principle for Research in Education and Social Sciences*. Samaru, Zaria: Asekome Publishing Company.
- Shawl, A. (2003). An Adoption of Problem-Based Teaching and Problem-Based Learning to Improving The Teaching of Radioactivity. *Chanyes Journal of Elementary Science*, 3(1), 14-18.
- WAEC. (2007). *West African Examination Council Chief Examiner's Report*. Lagos, Nigeria.
- West, J., & Veenstra, A. (2012). Can Toad or Computer Mouse? Real and Computer-Simulated Laboratory Exercises in Physiology Classes. *Australian Journal of Education*, 56(1), 56-67.
- Yusuf, M. O. (2007). Influence of Video and Audio Tapes Feedback Modes on Student Teachers' Performance. *Malaysian Online Journal of Instructional Technology*, 3(1), 29-35.